

# MONTHLY WEATHER REVIEW,

AUGUST, 1877.

## WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

## INTRODUCTION.

The present REVIEW for the month of August depends upon all data received up to the 14th of September from the Canadian Meteorological Service, the United States Navy, the Army Post Surgeons, Voluntary Observers and the United States Signal Service. The most interesting features have been: First, the unusually low barometric pressure over the Atlantic and Gulf States. Second, the general excess in temperature. Third, the large number of heavy local rains. Fourth, the general deficiency of rain in the Middle States, and consequent droughts.

## BAROMETRIC PRESSURE.

*In General.*—The general distribution of barometric pressure for the month is shown by the isobars on Chart II, from which it will be seen that the highest pressure has been off the South Atlantic coast, a small portion of which is included in the isobar of 30.00. The pressure has diminished very regularly from the coast in a northwest direction to Dakota, where the lowest average for the month is found. There has been a general deficiency in pressure, which is the most decided in the South Atlantic and Gulf States, where the mean barometer is the lowest it has been since the organization of the meteorological division of the Signal Service. The pressure in the Rocky Mountains and on the Pacific coast has been nearly normal.

*Barometric Range.*—The greatest range of the barometer over the whole country east of the Rocky Mountains, was about 1.09 inches, as may be seen from the following table, which gives the maximum and minimum pressures that occur on the tri-daily maps near the centres of the respective areas of high and low barometer:

LOW AREAS.				HIGH AREAS.			
No.	Location.	Date.	Minimum Pressure.	No.	Location.	Date.	Maximum Pressure.
I	Fort Garry.....	Aug. 1st, 7:35 a. m.....	29.67	I	Father Point.....	Aug. 1st, 7:35 a. m.....	30.92
II	Chatham.....	Aug. 4th, 4:35 p. m.....	29.54	II	Breckenridge.....	Aug. 2nd, 7:35 a. m.....	30.22
III	Bismarck .....	Aug. 4th, 4:35 p. m.....	29.44	III	Auenssta.....	Aug. 12th, 7:35 a. m.....	30.13
IV	Bismarck .....	Aug. 9th, 4:35 p. m.....	29.62	IV	Sydney .....	Aug. 20th, 11 p. m.....	30.38
V	Bismarck .....	Aug. 10th, 4:35 p. m.....	29.69	V	Breckenridge.....	Aug. 31st, 11 p. m.....	30.25
VI	Omaha .....	Aug. 15th, 4:35 p. m.....	29.71				
VII	Bismarck .....	Aug. 16th, 11 p. m.....	29.29				
VIII	Bismarck .....	Aug. 20th, 7:35 a. m.....	29.40				
IX	Bismarck .....	Aug. 23rd, 4:35 p. m.....	29.39				
X	Bismarck .....	Aug. 25th, 11 p. m.....	29.56				

The greatest local barometric ranges have been, as follows: 0.84 at Pembina, 0.72 at Breckinridge and Fort Dodge, 0.68 at North Platte, 0.70 at Eastport.

The least local barometric ranges have been as follows: 0.16 at Los Angeles, 0.17 at San Diego; 0.18 at Yuma; 0.19 at Key West; 0.32 at Galveston; 0.34 at Indianola; 0.37 at St Marks and San Antonio; 0.38 at Jacksonville, New Orleans, Corsicana and Fort Gibson; 0.39 at Shreveport and Jacksboro. An examination of the foregoing table shows that during August the least ranges have, in general, been near the coast, and the greatest in the plateau east of the Rocky Mountains.

*Areas of High Pressure in General.*—The areas of high pressure during the month have been due, in part, to the encroachments of the general area of high pressure that exists during the summer months in the North Atlantic ocean, and in part to cold, dry air flowing from the Rocky Mountain region in British America and entering the United States near Dakota and Minnesota—generally in rear of areas of low barometer. There also have been several instances of a marked rise of the barometer in advance of areas of depression, where the supply of air was not apparently obtained from either of the two sources above mentioned. This was notably the case when the barometer rose in Tennessee and the Ohio valley in advance of depression No. VII, as described in high area No. IV.

No. I.—This is the pressure described as No. VII in the July REVIEW. On the morning of the 1st it was highest near Father Point, Canada, the isobar of 30.30 extending into eastern Maine, and the isobar 30.20 nearly surrounding New England. It slowly extended along the north Atlantic coast, and disappeared as a high pressure on the 3rd, with southerly winds, in advance of low barometer No. I.

No. II.—The barometer rose on the 2nd in the Northwest and Upper Lake region, in rear of low pressure No. I, and moved in an easterly direction over the Lake region, with cold northerly winds, and, on the 4th and 5th, slowly extended to the East Gulf and South Atlantic coast, giving rise to the southerly winds that prevailed on the 6th and 7th from that coast to the Lake region. This high area was accompanied by the cold weather that lasted through the first week of August over the country east of the Mississippi river. It disappeared as a high pressure off the South Atlantic coast on the 7th.

No. III.—The pressure rose slightly above the average in the Gulf States on the 10th, and in the South Atlantic States on the 11th, in advance of low pressure No. IV, giving rise to the southerly winds that prevailed from the 10th to the 13th in Tennessee, the Ohio valley and Middle States. It had no movement of translation, and disappeared as a high pressure on the 15th.

No. IV.—This is the most interesting high area of the month; the pressure rose slowly on the 11th and 12th, with winds from the north and west, in Manitoba and the Northwest, in rear of depression No. IV. It remained nearly stationary until the 15th, when it gradually extended to the Gulf States, giving rise to light "northerns" in Texas. On the 15th and 16th it extended, with diminishing pressure, into the South Atlantic States, giving rise to the southerly winds that blew from the 15th to 17th, inclusive, in those States. On the 18th, 19th and 20th, the highest pressure slowly moved into the Ohio valley and Lower Lake region, with the barometer rising in advance of depression No. VII. On the 21st the highest pressure was in the Atlantic coast States and the St. Lawrence valley. On the morning of the 22nd the highest barometer was near the Middle Atlantic coast, giving rise to southerly winds in the Middle States and New England and to northeast winds in the South Atlantic States. On the 23rd, 24th and 25th the highest pressure moved to Nova Scotia. On the 25th and 26th the pressure rose along the Atlantic coast in advance of depression No. IX, then central in the Northwest. On the morning of the 27th the isobar of 30.10 included all the country east of the Mississippi valley, except the Upper Lake region. At 7:35 a. m. of the 28th the isobar of highest pressure, 30.20, had been transferred to the Middle and South Atlantic States and Tennessee. On the 28th and 29th, during the progress of low area No. IX across the Lake region, the highest pressure was transferred to the Gulf States. On the morning of the 30th the isobar of 30.10 included all the Gulf States; it then slowly extended, with diminishing pressure, into the South Atlantic States, and, at 11 p. m. of the 31st, the high area was confined to the coast stations of the two last-named districts.

No. V.—The pressure rose rapidly, in rear of depression No. X, in Manitoba and the Northwest during the night of the 30th, accompanied by cold northerly winds. On the 31st the high barometer extended over the Upper Lake region, Lower Missouri and Upper Mississippi valleys. The further history of this area will belong to the September REVIEW.

*Areas of Low Pressure in General.*—Ten areas of low pressure are described in the following list, of which six only were sufficiently well-defined to justify the charting of their tracks, as given on Map No. I: The charted tracks of centres of areas of low barometer show that the storms of this month were, in general, confined to the northern States of the Union, and show a decided correspondence with those of previous years. There are three cases where the fall of the barometer on the north Pacific coast, taken in connection with the preceding and subsequent wind-directions, justify the belief that the corresponding areas of depression moved from the Pacific slope over the Rocky Mountains into the plateau east of these mountains and north of the Platte river, where their further history is given in Nos. III, IX and X.

No. I.—This depression was described as No. VIII in the July REVIEW. The centre of low pressure was, on the 1st, in Canada, and there is not sufficient data to justify the charting of its track. It disappeared in advance of high pressure No. II. The amount of precipitation, within the limits of the map, was unusually small.

No. II.—There was a marked fall of the barometer in the South Atlantic States on the 2nd, which district was then, in all probability, in the northwest quadrant of an extensive depression, whose centre was off

that coast, and in or near the Gulf stream. Northeast winds prevailed from New York to Florida. The depression moved along the Atlantic coast, accompanied by northeast winds, backing to northwest, until the afternoon of the 4th, when the pressure was lowest in Nova Scotia. At this time, it was apparently merged with the low area described as No. I, which joined it, moving in a southeasterly direction over the St. Lawrence valley. Light, but cold, rains fell at the Atlantic coast stations. Its track cannot be traced with sufficient accuracy to chart.

No. III.—On the 1st and 2d the barometer was low in British Columbia and Washington Territory. On the 2d the winds in the Lower Missouri valley shifted to southerly, and on the 3d and 4th the same shift took place in the Upper Mississippi valley. The lowest pressure was in Dakota on the 4th. The barometer rose in Manitoba on the 5th, with northwest winds in rear of this depression. On the 6th southerly winds prevailed from the Gulf and South Atlantic coast to the Lake region, while cold north and west winds were blowing in the Northwest. On the 7th the wind directions showed that the lowest pressure was north of Lake Superior. On the 8th the lowest barometer was central north of Lake Huron. Up to this time its path had been too indefinite to be charted; it then slowly progressed in a southeasterly direction, central in Ontario, Canada; it then moved with an easterly track over New England, and disappeared off the coast of Nova Scotia on the 11th. It was accompanied on the 9th and 10th by general rains in the Lake region, Middle States and New England, which were the more abundant after the winds had shifted to colder north and west.

No. IV.—The northerly winds that had been blowing in the Northwest in rear of depression No. III, shifted on the 9th and 10th to warmer southerly in advance of the low area now to be described. On the 10th the winds in Dakota and Wyoming shifted to colder northerly, and at 11 p. m. of this date the lowest pressure was near Omaha; up to this hour no recorded precipitation accompanied this depression, but on the 11th light rain generally fell in Tennessee, the Ohio and Upper Mississippi valleys and Lake region. On the 12th the lowest pressure was in the Upper Lake region, but its track is too indefinite to be charted on that day. On the 13th the centre of the depression appears to have been in southern Michigan or northern Indiana or Ohio. On the 14th the lowest pressure was over the Lake region, but its track cannot be accurately charted. On the 15th the low area moved across the Middle States, and on the 16th along the New England coast. This depression was unusually sluggish in its progress to the east, and especially so over the Lake region, where it was detained for four days. The high temperature that prevailed, with moist southerly winds, in its southeast quadrant during its progress, had much to do in raising the temperature of the Atlantic States above the mean for the month. Copious rains fell from the Mississippi river to the Atlantic coast, and apparently with equal frequency and abundance in the east, south and west quadrants of this depression.

No. V.—On the 15th, the winds in Dakota and Nebraska shifted to southerly in advance of a depression then developing in Montana. By the 16th, the winds in the Northwest had shifted to the north and west, in rear of this low pressure, which passed beyond our stations into Canada, north of Lake Superior. Light rain accompanied this low area, which mostly fell in the Southwest quadrant after the veering of the winds to colder northwest.

No. VI.—On the 17th a trough of low pressure extended from Lake Superior to Kansas, with opposing southerly and northerly winds. This low area remained nearly stationary in position, and was by the 18th filled up by the inflowing currents of air. Light rain fell on these two days in the Northwest and Lake region. No track is charted.

No. VII.—On the afternoon of the 18th, a low pressure apparently developed in the plateau east of the Rocky Mountains and north of the Platte river. On the 19th, the winds in Wyoming had veered to colder northwest, and the centre of the low area was in Dakota. On the 20th, the low area moved slowly to the east. On the afternoon of the 21st, a trough-like depression extended from the Upper Lake region to the West Gulf States, into which blew cold northerly and warm southerly winds, giving rise to copious showers that fell from the Lake region to the Gulf. On the afternoon of the 22nd, the trough of lowest pressure extended from Lake Erie to the East Gulf, with abundant precipitation confined, in general, to the limits of the isobars of lowest barometer. On the 23rd, the isobars of lowest pressure assumed the more usual elliptical form, remaining nearly stationary over the Ohio valley and Lake region. For several days the barometer had been slowly rising at the centre of the depression, and, on the 24th and 25th, being filled up by the inflowing air, it ceased to exist as a low pressure. On the 23rd and 24th, abundant rain fell in the Middle States and New England—the east quadrant of the depression. From the 22nd to the 24th, its movements were so slow that the probable track of low barometer can only be charted by a broken line, which extended on the 23rd nearly to Tennessee. This is the second instance in this month when the Lakes appear to have exercised a detaining influence on the movement of translation of a low area to the east. In this depression, as well as No. IV, rain fell in equal abundance in the east, south and west quadrants of the low area, which is an unusual circumstance in storms of the United States, in the latitudes where the tracks of these low barometers are charted.

No. VIII.—On the 23d and 24th a slight depression moved from Dakota in a northeasterly direction to the north of Lake Superior; it only possessed features of little interest, and was rapidly followed by depression No. IX.; its track is not charted.

No. IX.—On the 23d and 24th the barometer was low in Oregon and British Columbia, and the wind directions show that this depression had advanced on the 25th into Montana and Dakota. On the 26th and 27th cold northwest winds blew in Dakota and Manitoba, while southerly winds prevailed from the Gulf to the Lake region. On the 28th this depression, whose charted track is confined to the Northwest, was filled up by air inflowing from the high areas to the north and south of it respectively. While it existed abundant rain fell in its eastern quadrant, where heavy thunder-storms were generally reported.

No. X.—On the 28th the barometer fell at the North Pacific coast stations. On the 29th this depression crossed the Rocky Mountains, and there was a rapid fall of the barometer in the Northwest, where the northerly winds that had been closing up the rear of depression No. IX shifted to warmer southerly. At 4:35 p. m. of the 30th, the lowest pressure was in Minnesota, and colder northwest winds had begun to blow in Manitoba. At 7:35 a. m. of the 31st, the lowest pressure extended in a trough from Lake Superior to Nebraska between the two areas of high barometer, one on the South Atlantic coast, and the other rapidly advancing with cold northerly winds from the British Possessions. At 11 p. m. the centre of lowest pressure had moved into the St. Lawrence valley near Montreal. Considerable rain fell in the southeast quadrant of this depression, but was rapidly followed by clearing weather, due to the cold dry air furnished by the northwest winds. Its track shows that the velocity of the centre of low barometer was much the greatest of any storm during the month. The further history of this low area will belong to the September Review.

## TEMPERATURE OF THE AIR.

*In General.*—The general distribution of temperature for the month is shown by the isotherms on Chart No. II. A comparison with the averages for August, during the past seven years, shows that the temperatures have been from one to two degrees above the normal throughout the Gulf and Atlantic States, St. Lawrence valley, Lake region and Minnesota, but have been about normal in the Ohio, Mississippi and Missouri valleys. On the Pacific coast, the monthly mean for San Diego is six degrees below the average; at San Francisco it is about normal, and at Portland, Or., two degrees above.

*Monthly mean temperatures, at special points*, have been as follows: Mt. Washington, 48°.9.

*Maximum and Minimum Temperatures.*—Maximum temperatures, at Signal Service stations, above 95°, have been reported as follows: 96°, Savannah, New Orleans, Leavenworth, Salt Lake City; 97°, Augusta, Galveston; 98°, Montgomery, Fort Gibson, Fort Sill, Boise City, Winnemucca; 99°, Mobile, Vicksburg, Shreveport, Denver; 100°, Indianola, Jacksboro, Concho, Dodge City; 102°, Denison, North Platte; 103°, Corsicana, Red Bluff, Visalia; 104°, Brackettville; 108°, San Antonio; 112°, Yuma; 116°, Stanwix. From stations not included in Signal Service, *extreme temperatures* have also been reported as follows: 100° at Fort Rice, Dak., Independence, Iowa; 101° at Atlanta, Ga.; 102° at Baton Rouge, La., Chepachet, R. I., Gilmer, Clarksville and Melissa, Tex.; 103° at Fort McKavett, Tex.; 104° at New Ulm and Mesquite, Tex.; 105° at Fort Lyon, Col.; 108° at Fort McPherson, Neb., Fresno, Cal.

*Minimum temperatures* below 45°: 44°, Cheyenne, Marquette; 43°, Boise City; 41°, Breckenridge; 40°, Pembina; 36°, Winnemucca. It will be seen that all the minima occurred north of the 41st parallel of latitude, and excepting the one on Lake Superior, west of the 96th degree of longitude.

*The maximum temperatures* of the month occurred, in a general way, as follows: From the 1st to the 7th, in the Gulf States, Ind. Ter., Georgia, Tennessee, the Ohio valley and Lower Lake region; from the 17th to the 24th, in Minnesota, Lake region and New England; on the 28th and 29th, in New England and the Middle States, and on the 30th and 31st in the Missouri, central Mississippi and Ohio valleys and interior of the Southern States.

The minima occurred on the 21 and 31, along the New England coast; on the 4th, 5th and 6th, over the Lake region, Middle States and New England; from the 15th to the 19th, in the Southern States and Ohio valley; from the 22d to the 26th, over the Western plains and Mississippi valley, and on the 31st in northern New York and New England.

*Ranges of Temperature.*—The largest monthly and diurnal ranges have been respectively as follows: Winnemucca, monthly, 66°, diurnal, 48°; Boise City, 55°, 39°; North Platte, 51°, 41°; Denver, 52°, 45°; Visalia, 51°, 44°; Pembina, 49°, 38°; Breckenridge, 49°, 42°; Roseburg, 47°, 40°; Red Bluff, 47°, 39°; Salt Lake City, 47°, 25°; Cheyenne, 47°, 43°; North Platte, 47°, 33°; Yankton, 47°, 31°. The least monthly and diurnal ranges have been respectively: Key West, 17° and 16°; Cape Hatteras, 21°, 16°; Wood's Holl, 22°, 15°; Charleston, 22°, 17°; New Orleans, 23°, 16°; San Francisco, 23°, 19°; San Diego, 24°, 19°; Cape May, 24°, 17°; Cape Henry, 25°, 19°; Jacksonville, 25°, 20°. It is found, by comparison, that the monthly ranges exceed in general the diurnal by about ten degrees; that the least ranges occur,

without exception, at sea-coast stations, the most exposed stations having the least ranges; and that the greatest ranges occur at the more elevated stations, especially in the region north of the 40th parallel and west of the 96th meridian.

*Frosts* were observed as follows:—On the 6th, at Denver, Col.; 13th, at Logansport, Ind., and Cape May; 22nd and 23rd, at Fort Madison, Iowa; 26th, Camp Halleck, Nev., and Virginia City, Mon.; 27th, Bismarck, Dak.; 31st, Toledo, Ohio, and nightly at Halleck station (C. P. R. R.) Nev., and Summit, Col.

*Ice.*—The formation of ice, rather than frosts, was reported from Halleck station, Nev., nightly during latter part of month.

## PRECIPITATION.

*In General.*—The general distribution of rain for the month is shown on Chart No. III. The table in the lower left-hand corner gives the precipitation, in the various districts, by which it will be seen that there has been quite a large deficiency in the Middle, South Atlantic and Gulf States, and in Minnesota, while a slight excess is reported in Tennessee and the Upper Lake region. It is a notable feature of the precipitation for this month, that the most of it has occurred during heavy showers of short duration and over quite limited areas, thus giving to certain districts an excess, at the expense of the surrounding country. Considerably over the average amount has fallen in Oregon, but with one exception of 0.03, no rain is reported in California.

*Special heavy rains.*—The following are the most notable cases of heavy rains that have been reported: 1st, Key West, 1.47; Cape Lookout, 3.85 inches; (1.50 in. in ten minutes.) 2nd, Goldsboro, N. C., (2nd and 3d) 2.00 in.; Weldon, N. C., 2.62 in.; Greenville, N. C., (2nd and 3d) 5.69 in. 3d, Dodge City, Kan., 2.42; Cape Lookout, 3.10 in. 6th, Denver, Col., 1.00 in 25 minutes; Charleston, 1.27; Keokuk, Iowa, 2.40; North Platte, Neb. 1.84. 7th, Portland, Me., 2.38; Ft. Gibson, Ind. Ter., 1.94; Ft. Sill, Ind. Ter., 1.21 in.; Goldsboro', N. C., 2.50 in. 8th, Augusta, Ga., 1.82; Memphis, Tenn., 2.78; Escanaba, Mich., 1.27 in. in 20 minutes; Rio Grande, Tex., 2.65 in.; Forayth, Ga., 2.50 in., over 2 inches falling in 45 minutes; Brookhaven, Miss., 2.10 in. 9th, Portland, Me., 2.15; Wilmington, N. C., 2.84; Orono, Me., (9th and 10th) 2.30 in. 10th, Eastport, Me., 2.12 11th, North Platte, Neb., (in 30 minutes) 2.00. 12th, Cape May, N. J., 2.10; North Platte, Neb., 1.46. 13th, New Haven, Conn., 2.75. 14th, Newark, N. J., Alpena, Mich., 2.50; Tybee Island, 2.02. 15th, Portsmouth, N. C., 2.29; Freehold, N. J., 2.48 in. 16th, Mt. Washington, N. H., 2.90. 18th, Hartford, Conn., 3.45 inches; Tybee Island, 1.80. 19th, Tybee Island, 2.45. 20th, Oregon, Me., (20th and 21st) 3.45 in.; Emerson, Neb., 2.10 in.; Howard, Neb., 2.02 in.; Wolfeboro, N. H., 2.60 in.; Tabor, Iowa, 2.61 in. 21st, Corsicana, Tex., 2.01; Fort Gibson, Ind. Ter., 1.42; Denison, Tex., 1.16; Jacksboro', Tex., 2.01; Louisville, Ill., 2.00 in.; Beloit, Wis., 2.00 in. 22nd, (22nd and 23d, Nashville Tenn., 2.80; St. Marks, Fla., 3.95; Savannah, Ga., 1.92; Martinsville, Ill., 2.52 in.; Spiceland, Ind., 2.17 in. 23d, Wilmington, N. C., 3.51; Alpena, Mich., (23d and 24th) 4.57; Alpena, Mich., 3.36 in. (1.07 in. in 35 minute-); Martinsville, Ill., 2.03 in. 24th, Trenton, N. J., 4.39 in. 25th, Albany, N. Y., 1.63; New London, Conn., 2.31, (25th and 26th); Mt. Washington, (25th and 26th) 3.83; Portland, Me., (Ft. Preble) 25th and 26th, 2.20 in.; Atoe, N. J., 2.68 in.; Lunenburg, Vt., (25th and 26th) 2.60 in.; Tabor, Iowa, 3.00 in.; Mystic, Conn., 4.00 in.; Somerset, Mass., 2.28 in.; Fall River, Mass., (25th and 26th) 2.60 in.; Springfield, Mo., 2.00 in., (in 20 minutes.) 26th, Newport, R. I., 1.97; Breckenridge, Minn., 1.53; Nora Springs, Iowa, (26th and 27th) 2.40 in. 27th, La Crosse, Wis., 2.55; Boonsboro, Iowa, (27th and 28th) 5.15 in. 28th, Dubuque, Iowa, 2.80; Ames, Iowa, (28th and 29th) 4.12 in.; Cleveland, Iowa, 2.60 in.; Geneva, Wis., 2.13 in.; Beloit, Wis., 4.00 in. 29th, Milwaukee, Wis., 1.63; Boonsboro, Iowa, 4.10 in. 30th, La Crosse, Wis., 1.69; St. Paul, Minn., 1.83. 31st, Norfolk, Va., 1.75; Cleveland, Ohio, 2.59; Detroit, Mich., 2.02; Erie, Pa., 1.11; Port Huron, Mich., 1.22; Sandusky, Ohio, 2.80; Toledo, Ohio, 1.74; Martinsville, Ill., 2.75 in.; Painesville, Ohio, 2.80 in.; Hudson, Ohio, 3.40 in.; Venice, Ohio, 2.10 in.; Cleveland, Ohio, 2.07; Manitowoc, Wis., 2.19 in.

*Small Monthly Rain-falls.*—The following stations report small rainfalls: In California; San Francisco, Sacramento, Visalia, Los Angeles and San Diego report no rain-fall; Red Bluff, 0.03; in Arizona; Yuma, 0.06; Stanwix, 0.13; in Nevada, Winnemucca, 0.00; Pioche, 1.18; Salt Lake City, Utah, 0.28; Roseburg, Oregon, 0.25; Boise City, Idaho, 0.09; in Texas; Stockton, 0.37; Eagle Pass, 0.35; Edinburg, 0.11; Fredericksburg, 0.19; Castroville, 0.00; Shreveport, La., 0.20; in the Middle States, Baltimore, 0.64; Philadelphia, 0.66; in the Province of Ontario, Can., Port Stanley, 0.96; Toronto, 0.12, and Kingston, 0.47.

*Large Monthly Rainfalls.*—Rainfalls of seven inches or more are reported, as follows: Mount Washington, 11.11; in Florida; Daytona, 10.77; Punta Rassa, 8.33; St. Marks, 7.90, and St. Augustine, 7.05; North Carolina; Wilmington, 10.46; Greenville, 9.10; Brookhaven, Miss., 8.15; Boonsboro, Iowa, 10.00; Martinsville, Ill., 7.84; in Michigan; Alpena, 7.93; Detroit, 7.23; Fort Wayne, 7.85; in Maine, Portland, 7.90; Cornish, 7.45, and Chatham, N. B., 7.48.

*Droughts.*—Droughts, injurious to vegetation, have been reported as follows: Michigan—Salem, 22nd, “the most severe drought known here for some time, rendering plowing impossible, terminated, but present showers will put ground in good condition;” Northport, “corn and early potato crops injured by drought.” Maryland—Baltimore, 25th, “in the country around, corn is suffering, grass badly burned, small streams and wells failing;” Druid Lake lower than at any time since 1872;” Harford county, drought of greater or less severity. Pennsylvania—Philadelphia, records smallest rain-fall for seven years. Ohio and Indiana—in northern portions, “especially dry summer: considerable portion of corn crop utterly hopeless;” Ringgold, corn, potato, tobacco and fruit crops injured; Westerville, corn crop suffering. Iowa—Rockford, 12th, “crops suffering;” Cresco, 16th, “country all parched up: corn and vegetables nearly destroyed;” Guttenburg, “corn damaged by dry weather;” Nora Springs, drought continued until the 20th, injuring potatoes and corn. Texas—Clarksville, cotton growth checked by ten weeks drought. Virginia—Wytheville, “drought severe, ground too hard to plow.” Tennessee—Knoxville, “late crops injured by drought.”

*Floods.*—New Jersey—16th. R. R. track at Carpenterville flooded; 24th, Trenton, “doing much damage and delaying almost all trains.” New York—25th, Albany, basements flooded and much damage to new buildings and excavations. Connecticut—New Haven, 13th, damage to cellars, &c.; New London, 25th, damage to railroads \$250,000. New Hampshire—Mt. Washington, 26th, “bridges in valleys around base of mountain washed away.” Missouri—St. Louis, 31st, streets flooded, Iron Mountain R. R. track submerged.

*Hail-storms.*—Hail has been reported as follows: 2nd, Bismarck, Dak.; 3rd, Summit, Col.; 5th, Breckinridge, Minn., North Argyle, N. Y.; 6th, Denver, Col., Monticello, Iowa; 7th, Portland, Me., Mt. Washington, N. H., Cheyenne, W. T., Lunnenburg, Vt.; 8th, Escanaba, Mich., North Argyle, Hector and Starkey, N. Y.; 10th, Owasco and Albany, N. Y., Mt. Washington, N. H., Erie, Pa., Woodstock, Vt.; 11th, Cordova, Ill., Yankton, Dak., Boonsboro, Iowa; 12th, Harrisburg, Pa., Murphy, N. C.; 13th, Canterbury, Del., Indianapolis, Ind., Vevay, Ind., Bethel, Ohio; 15th, Summit, Col.; 16th, in northern part of N. J., Lehman and Delaware, Pike Co., Pa., Ft. Sanders, W. T., Como, Ill., Genoa, Neb., Oneida, N. Y.; 17th, near Houston, Texas, St. Louis, Mo., Ft. Bridger, W. T., Ringgold, O.; 18th, North Platte, Neb., Rockford, Iowa, near Mendor, Mass., Jacksonburg, Ohio, Brownsville, Pa.; 19th, Camp Hancock, near Wilkesbarre, Pa., Ft. Sanders, W. T.; 20th, Emerson and Genoa, Neb., Oregon, Mo.; 21st, Fallston, Sandy Springs and near Centreville, Md., track of storm two to three miles wide and nearly ten miles long; great damage to corn and fruit; Denison, Texas, Manitowoc, Wis., Brookhaven, Miss.; 22nd, Southington, Conn.; 25th, Tabor, Iowa, Emerson, DeSoto, Plattsburgh, Clear Creek and Howard, Neb., Oregon, Mo.; 26th, Linden, N. J.; 28th, Brookhaven, Miss., DeSoto, Neb., Beloit, Wis.; 29th, Amoskeag, N. H., Austin, Tenn.; 30th, Summit, Col.; 31st, Sandusky, Cleveland, Painsville, Venice, Ohio, Milford, Ind., Detroit, Mich. Hail was reported on the summit of Pike’s Peak on 14 days.

*Large Hail-stones.*—8th, at Escanaba, stones unusually large. 9th, Gloucester, near Ottawa, Ontario, Can., weighed 3 ounces, completely destroying crops. 19th, Camp Hancock, Wilkesbarre, Pa., large as marbles. 21st, Centreville, Md., one weighing one-fourth of a pound. 29th, Austin, Texas, large hail stones, damaging tobacco and corn. 31st, Cleveland, Ohio, half inch to one and a quarter inch in diameter; Detroit, half inch in diameter.

*Snow.*—Snow was reported on ten days on the summit of Pike’s Peak, Col.

*Rainy Days.*—The number of days on which rain has fallen, as recorded by Signal Service observers, ranges as follows: New England, 9 to 19; Middle Atlantic States, 8 to 14; South Atlantic States, 10 to 16; East Gulf States, 6 to 16; West Gulf States, 1 to 7; Tennessee and the Ohio valley, 8 to 12; Missouri valley, 9 to 10; Upper Mississippi valley, 2 to 12; Upper Lake region, 7 to 16; Lower Lake region, 9 to 17; Rocky Mountain stations, 3 to 13; California, 0 to 2.

*Cloudy Days.*—The number of cloudy days, reported during the month by Voluntary Observers and Army Surgeons, ranges about as follows: New England, 4 to 13; Middle Atlantic States, 1 to 11; South Atlantic States, 0 to 5; East Gulf States, 1 to 7; West Gulf States, 0 to 3; Tennessee and Ohio valley, 0 to 8; Lower Missouri valley, 0 to 4; Upper Mississippi valley, 0 to 7; Lake region, 0 to 11; Rocky Mountain stations, 0 to 7; California, 1 to 7.

## RELATIVE HUMIDITY.

The average relative humidity for the month ranges about as follows: New England, 71 to 88; Middle Atlantic States, 61 to 78; South Atlantic States, 69 to 78; East Gulf States, 58 to 81; West Gulf States, 55 to 67; Tennessee and Ohio valley, 64 to 69; Lower Missouri valley, 63 to 66; Upper Mississippi valley, 56 to 70; Upper Lakes, 64 to 75; Lower Lakes, 63 to 73; California, 32 to 79.

High stations, not corrected for elevation, report as follows: Mt. Washington, 88; North Platte, 57; Cheyenne, 37; Denver, 35; Santa Fe, 37; Salt Lake City, 25.

## WINDS.

*In General.*—The prevailing winds at Signal Service stations are shown by arrows on chart No. II, from which it will be seen that the prevailing winds were southerly throughout the Atlantic States and west of the Mississippi, tending to westerly in the former and to easterly in the latter district. Throughout the Mississippi and Ohio valleys, Tennessee and Lake region, the winds were northerly, tending to westerly, especially over the Lower Lakes, Ohio valley and Tennessee. On the Pacific coast the prevailing winds were northerly or westerly.

*Total Movements.*—The largest total movements have been as follows: Mt Washington, 13,075 miles; North Platte, 9,591; San Francisco, 8,923; Cape May, 8,260; Dodge City, 8,127. The smallest movements have been as follows: Indianapolis, 2,012; Lynchburg, 2,026; Augusta, 2,107; Nashville, 2,247; Springfield, 2,320.

The highest velocities in miles per hour, have been as follows: 5th, Breckenridge, 50 miles; 6th, Denver, 75; North Platte, 60; 7th, Cape Lookout, 60; 21st, Cambridge, 50; 28th, North Platte, 66; 29th, Morgantown, 59.

*Local storms, tornadoes, &c.*, have been reported, as follows, (unless specially noted, it is understood that the following list of high winds include only local storms, and not such gales as prevailed simultaneously over a large region): 6th, about 4.50 p. m., a severe hail-storm visited Denver, Col., lasting about twenty minutes. For about three minutes the wind blew from the northwest, at the rate of 75 miles per hour, tearing off portions of the roofs of the jail and Broadway school building. The rain-fall was the heaviest experienced for several years, amounting to one inch in 25 minutes, flooding cellars and doing considerable damage to stocks. Hail commenced at 5 p. m., and fell for 8 minutes, doing extensive damage to window glass. 6th, a severe wind and rain storm occurred at Council Bluffs, Iowa, between two and three o'clock a. m., coming from the northwest. The new building of the Deaf and Dumb Institution was left a mass of ruins; the roof was caught up bodily, carried to the southeast and literally torn into fragments, one piece weighing not less than five tons, being carried forty rods, while other pieces weighing between two and three tons, were carried still farther away, and fragments scattered over the country, for more than a mile. To give some idea of the force of the wind, the front wall of the main building, having a stone basement two feet in thickness, is said to have been moved seven inches at the top, gradually decreasing to about one half an inch at the base; the brick walls of the third story in some places were blown entirely down, and the fourth story was almost entirely demolished. The buildings in the rear of the main building and some that protected, were also greatly damaged; the roofs of the engine and gas houses being torn away and two chimneys blown down. 8th, Starkey, N. Y., 1 p. m. Heavy hail-storm, lasting twenty minutes; came from NW; path one mile wide. Hail-stones were size of cherries. Grape, peach, tobacco and corn crop badly damaged. The wind preceding the hail, blew down trees, took tops off grain-stacks, &c. 9th, Orrville, Ohio, severe storm fields of corn destroyed, the stones being as large as walnuts. 10th. A tornado visited Coney Island N. Y., doing considerable damage to hotels and bathing-houses; several beams and timbers of the new depot were also torn from their positions and the car-house blown level with the ground. 11th, early this morning a severe wind and hail storm visited Cordova, Ill., destroying two churches, two business houses, several dwellings, and doing considerable other damage; at Walcott, near Davenport, Iowa, six horses were killed by lightning. 12th, Jamestown, N. Y., at 1.15 p. m., "during a thunder-storm, a ball of fire, apparently two feet in diameter, entered a church, killing one boy and severely burning several persons; instantly the whole interior of the building grew hot and dry, the air hard to breathe and supremely oppressive." 12th, Louisville, Ky., 2 a. m., severe thunder-storm, doing some damage. 14th, New York, heavy thunder-storm, one schooner capsized and another struck by lightning; Clinton, Ill., severe storm, completely destroying a church, school-house, mill and a number of dwellings, and doing great damage to crops; Stamford, Conn., violent tempest, uprooting trees, blowing down fences, destroying crops, track of devastation northeasterly and about half a mile wide; Ottawa, Ontario, Can., severe thunder-storm, doing considerable damage to buildings; at Aylwin a school-house was struck and damaged. 16th, a hail and severe thunder-storm passed over northern part of New Jersey; the track at Carpenterville was flooded several inches deep with hail-stones and water; at Springtown, one child was killed by lightning and several others rendered insensible; Glen's Falls, N. Y., house struck by lightning and one person killed. 16th, Concord, N. H., severe thunder-storm, during which several persons were stunned; Guelph, Ontario, Can., heavy and prolonged thunder-storm, streets flooded and considerable damage to goods stored in cellars, one man was killed and another stunned by the lightning. 17th, a heavy hail and thunder-storm raged from Houston, Texas, to south of Victoria. 18th, Hartford, Conn., 12:10 to 6:30 p. m., violent wind did much damage to trees and chimneys. Rain fall, 3.45 inches, flooding streets and cellars. 18th, Gofestown Centre, N. H., 4 p. m., heaviest thunder-storm ever known; Methodist church completely destroyed, loss, \$4,000, and several other buildings damaged. 21st, Chestertown, Kent county, Maryland, a violent wind and hail-storm, extending, also, to Queen Anne's

county; hail-stones, large as hen's eggs, doing much damage to orchards and window-glass. 21st, about 4 p. m., the sixth and most destructive hail-storm of the season occurred between Centreville and Ruthsburg, Queen Anne's county, Md., coming from the east and veering to southwest. The hail-stones were as large as hen's eggs; one, weighing one-quarter of a pound, killing poultry and breaking the leg of a hog. The destruction to fruit and grass amounts to almost a total loss, while the corn is more than one-third destroyed. 21st, Oconto, Wis., severe squall, doing damage to shipping in harbor. 24th, a severe thunder-storm visited Rochester, Charlotte and Summerville, Monroe county, N. Y., during which the lightning struck several buildings, stunning and burning a number of persons. A violent rain-storm also occurred in north portion of Harford county, Md., flooding streams and carrying away bridges, horses, cattle and sheep. 25th, Omaha, Neb., a severe wind and rain-storm passed over eastern Nebraska and Kansas, blowing a hurricane at Omaha about 3:30 a. m. Two spans of the Missouri river bridge, one hundred and fifty feet each, and the stable of the Omaha Omnibus Company, were blown down. At Omaha the tornado advanced from a point a little east of north along the course of the river; it appears that the atmospheric commotion was at first high above the country, and when the sudden fall of the river embankment was reached it swooped down in its course, spread havoc in its path, and as suddenly lifted itself again above the surrounding country. One observer says he saw an immense cloud passing down the river, lifting up the water in vast quantities and whirling it around in a funnel-shape. The spans destroyed were at the eastern terminus of the bridge; the wrought iron stringers and columns of the bridge-spans were twisted and bent like so many pieces of paper and carried partly into the river and partly against the eastern embankment of the river, on the south side of the bridge. 29th, New London, lightning struck barn at Fort Trumbull, killed one horse and set barn on fire. Macon, Ga., drayman struck and two mules killed by lightning. 30th, Pittsburgh, Pa., severe wind and rain storm, during which buildings and trees were damaged. 31st, St. Louis, Mo., heavy wind and rain storm, doing considerable damage at the Arsenal. Detroit, Mich., a series of storms, of unusual violence, uprooting trees, &c. Windsor, Ont., violent wind and hail. Sandwich, Ont., tornado moving in a southeasterly direction, damaged trees, houses, &c. Toledo, heavy wind, rain and hail-storm, hail as large as pigeon eggs; wind 36 miles per hour at 2 p. m. Collingwood, Cuyahoga Co., Ohio, new chapel totally destroyed by wind-storm. Sandusky, Ohio, a series of violent wind, rain and hail-storms visited this city; hail as large as musket balls. Cleveland, Ohio, a most severe wind and hail-storm struck city about 10 a. m., hail-stones fell as large as walnuts; trees, flagstaffs, churches, &c., were much damaged. About 11 a. m. the water rose in the Lake, at the mouth of the Cuyahoga river, about three feet, and flowed rapidly up stream, and about 4 p. m. again fell to about 40 inches below its normal height; at the government pier the total change in the water is reported to have been about seven feet. Pittsburgh, Pa., severe wind and rain-storm, damaging roofs, flooding cellars, &c. Erie, Pa., severe storm, with tremendous sea on Lake. Ypsilanti, Mich., severe storm, damage several thousand dollars. Adrian, Mich., terrific storm.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily weather indications with the telegraphic weather reports, for the succeeding twenty-four hours, shows a general per centage of omissions of 0.5 per cent., and of verifications of 82.7 per cent. Out of 3,698 predictions, 2,260, or 60.8 per cent., have been fully verified; 680, or 18.3 per cent., have been three-fourths verified; 487, or 13.1 per cent., have been one-half verified; 178, or 4.8 per cent., have been one-fourth verified; 93, or 2.5 per cent., have failed. The percentages of verifications for the four elements have been: weather, 83.3; wind, 79.5; temperature, 87.0; barometer, 81.8. The percentages of verifications by geographical districts have been: New England, 79.8; Middle States, 82.2; South Atlantic States, 81.1; East Gulf States, 81.6; West Gulf States, 85.0; Lower Lake region, 85.8; Upper Lake region, 82.3; Tennessee and the Ohio valley, 80.9; Upper Mississippi valley, 83.2; Lower Missouri valley, 84.2.

*Cautionary Signals.*—During the month 38 Cautionary Signals have been displayed at stations on the Gulf and Atlantic coast, and on the Lakes. Forty instances of high wind, where no signals were displayed, have also been reported from these stations. Telegraphic communication with the North Carolina coast stations was re-established on the 16th.

## NAVIGATION.

*Stages of Water.*—In the table on Chart III, are given the highest and lowest readings on the river gauges, for the month, from which it will be seen that a general fall has taken place in all the rivers, averaging in the Missouri, Ohio and Cumberland rivers, from two to four feet; in the Upper Mississippi from seven to thirty inches, and in the Lower Mississippi from five to fourteen feet. Occasional slight rises have occurred in consequence of heavy rains, the most marked occurring in the Upper Mississippi during the last

few days, and in the Missouri prior to the 21st, when a large portion of the river bank, between Fort Leavenworth and Weston, was washed away.

*Low water*, detrimental to navigation, has been reported, as follows: In the Alleghany, so low as to preclude navigation; On the 9th, the Ohio was reported shoaling badly, and navigation has continued suspended at Pittsburgh throughout the month; 17th, Licking river too low for even tow-boats; Illinois river very low at Kickapoo; on the 14th, navigation was reported practically closed on the Yellowstone. The Upper Mississippi, at Keokuk, was so low that boats could not cross Des Moines rapids; at St. Louis, on the 14th, so low that none but small boats could pass on east side of Arsenal, and, same date, channels at Memphis becoming alarmingly narrow and dangerous. New Orleans, 20th, great trouble to regular packets in approaching landings. On the 23rd, the Arkansas fell below three feet at Little Rock. On the 18th, the shipment of cattle at Shreveport was reported over until a rise occurred. Boats from Savannah to Augusta have had to land freight several miles below latter place.

## TEMPERATURE OF WATER.

*In General*.—The temperature of water, as observed in rivers and harbors, is shown in the table on Chart No. II. The average temperatures have been lowest at Eastport, 45°, and Marquette, 55°; and highest at Shreveport, 90°; Galveston, 88°; Key West, 88°; Augusta, 85°.

*Maximum and Minimum Temperatures*.—The highest maxima have been: Shreveport, 94°; Galveston, 92°; Key West, 91°; and lowest minima: Eastport, 44°; Duluth, 45°; Marquette, 52°.

*Ranges of Temperature*.—The least ranges have been: St. Francis, 1°; Norfolk, 2°; Eastport, 3°; Wilmington, Charleston and Cleveland, 4°.

## ATMOSPHERIC ELECTRICITY.

*Thunder-storms* were reported at stations, in the respective States, as follows: 1st, Ala., Mich., Fla., Ill., Ind., Kan., La., Miss., Tenn., N. C., Neb., Mo., N. Mex. 2nd, Dak., Ga., Ind., Kan., La., Miss., Ohio, Tenn., Tex., N. C., Mich., Fla. 3rd, Col., Conn., La., Me., N. J., N. Y., N. C., N. H., Ga., Mass., Wy. Ter., Fla., Minn., 4th, Kan., N. C., Wy. Ter., Fla., N. Mex. 5th, Dak., Me., Col., Iowa, Kan., La., Mo., Neb., N. Y., Vt., S. C., Fla., Minn., 6th, Ind., Ter., Kan., Ill., Iowa, La., Miss., Neb., N. Y., Wis., Fla., Col., Ala., Dak., 7th, Me., Mich., N. Y., Conn., Ill., Ind., Kan., La., Mass., Miss., N. J., N. C., Ohio, Tex., Vt., R. I., Tenn., N. H., Ala., Fla., Ga., Wis., Ind., Ter., Wy. Ter., 8th, N. Y., Conn., Fla., Ga., Ill., Iowa, Kan., La., Me., Mass., Miss., Mo., Neb., N. H., N. J., N. C., Pa., S. C., Tenn., Mich., Tex., N. Mex., 6th, N. Y., Conn., Me., Mass., N. J., Ohio, Pa., Vt., N. C., W. Va., Ga., Fla., Dak., 10th, Mass., N. Y., Conn., Dak., Fla., Ill., Ind., Iowa, Me., Neb., N. J., Pa., Vt., N. H., Mo., Utah., 11th, Mass., Neb., N. Y., Col., Dak., Ill., Ind., Iowa, Kan., Me., Mo., Ohio, Vt., Wis., Fla., Mich., Wy. Ter., 12th, N. Y., Col., Ill., Ind., Iowa, Kan., Ky., Me., Md., Mo., N. J., N. C., Ohio, Pa., Tenn., Vt., Va., Wis., Fla., Mich., D. C., 13th, Dak., Ga., N. Y., Conn., Ill., Ind., Kan., Ky., Me., Md., Mass., N. J., N. C., Ohio, Pa., S. C., Tenn., Tex., Va., Wis., R. I., W. Va., Fla., Mich., Ala., Ind., Ter., D. C., 14th, N. Y., Wy. Ter., Col., Conn., Dak., Fla., Ga., Ill., Ind., La., Mi., Mass., Miss., N. J., Ohio, Tenn., Vt., W. Va., Mich., Tex., N. Mex., 15th, Dak., N. Y., Conn., Ind., Md., Mass., N. H., N. J., N. C., Ohio, Pa., Va., Tenn., W. Va., Me., Fla., Neb., Mich., Tex., N. Mex., 16th, Ind., Ter., Me., Mich., N. Y., Conn., Dak., Fla., Ill., Iowa, Kan., Md., Mass., Neb., N. H., N. J., Ohio, Pa., Vt., Wis., Ga., Tex., 17th, Conn., Fla., Ill., Ind., Kan., Me., Mass., Miss., Mo., Neb., N. H., N. Y., Pa., Tenn., Tex., Vt., Wis., W. Va., Mich., Ind., Ter., N. C., 18th, Mich., Conn., Ill., Ind., Iowa, La., Me., Mass., N. H., N. J., N. Y., N. C., Tex., Vt., Va., Wis., W. Va., Ga., Fla., Minn., Idaho, Dak., Col., 19th, Mich., N. Y., Me., Mass., Miss., Ohio, Pa., Vt., Va., Wis., Ind., Ga., Wy. Ter., Dak., 20th, Ala., Dak., Ind., Ter., Iowa, Kan., Mass., Me., Neb., Ohio, Pa., W. Va., Tex., 21st, Fla., Ill., Ind., Iowa, Md., Mass., Miss., Mo., N. J., Pa., Va., Wis., Tenn., W. Va., Tex., Mich., Ga., Wy. Ter., D. C., 22nd, Mich., Conn., Fla., Ga., Ind., Mass., Pa., Neb., 23rd, Dak., Mich., Ga., Mass., N. C., Ohio, Fla., 24th, Dak., Mich., Fla., Iowa, Kan., Md., Mass., N. J., N. Y., Pa., Va., N. C., Minn., 25th, Dak., N. Y., Fla., Iowa, Kan., Mass., Mo., Neb., N. J., Pa., Vt., Va., R. I., La., Conn., 26th, Dak., Conn., Fla., Ill., Ind., Iowa, Mass., Minn., Miss., N. J., N. Y., Wis., Ga., Ala., 27th, Dak., Mich., Ga., Ill., Ind., Iowa, Me., Mass., N. H., N. C., Wis., Tex., 28th, Ala., Dak., Mich., Ill., Iowa, La., Mass., Minn., Miss., Neb., N. Y., Tenn., Tex., Wis., Fla., 29th, Ala., Dak., Me., N. Y., Conn., Ill., Ind., Iowa, Ky., Mass., Neb., N. J., N. C., Ohio, Pa., Tenn., Vt., Tex., R. I., W. Va., Idaho., 30th, Dak., Col., Iowa, La., Mass., Minn., Miss., N. H., Pa., S. C., Vt., Va., Wis., N. C., W. Va., Me., 31st, Mich., Dak., Ill., Ind., Iowa, La., Mass., Miss., N. J., N. Y., Ohio, Pa., S. C., Tenn., Va., Wis., Ala., W. Va., Ky., N. C., Fla., Mo.

*Distant thunder or lightning* was reported from stations in the respective States as follows: 1st, S. C., Ga., Ind., Vt., La., Ill., Miss.; 2nd, N. C., Dak., Tex., Va.; 3rd, Mass., N. C., N. J., Ga., Ind., Tex., N. Mex., Dak., Me., Va., D. C.; 4th, Miss.; 5th, La., Dak., Ala., Utah, N. C., Va.; 6th, Ga., Ind., Vt., La., Iowa, Ill., Tex.; 7th, Ind., N. C., Ga., Ala., Mich., Tex., N. Mex., Ohio, Pa., Va.; 8th, Va., Iowa, N. C., Mass., Ga.

La., Tex., Ill., N. J.; 9th, N. C., Ga., Fla., Mich., Tex., N. Mex., Ohio; 10th, Mass., N. C., N. J., Conn., Dak., N. Y., Ohio; 11th, Ind., Ty., Wis., Iowa, Minn., Ill.; 12th, Pa., W. Va., Iowa, Dak., Wy., Minn., Conn., Ill., Mich., N. Y., Ohio, Va., Wis.; 13th, S. C., Tenn., N. C., Ga., Mich., Iowa, Tex., Conn., Ill., Me.; 14th, Va., Ala., N. Y., N. C., Ga., Ill., Mass., Tenn.; 15th, S. C., Pa., N. Y., N. J., Ga., Conn., Dak., Mich., Tex., Ohio, Va.; 16th, S. C., Pa., N. Y., Ga., Ind., Ty., Iowa, Minn., Conn., Ill., Ohio; 17th, Iowa, Mass., Tex., Ga., Ill., N. Y., Wis.; 19th, Ohio, Dak., Mass.; 20th, Minn.; 21st, La., Neb.; 22nd, Ala.; 23rd, W. Va., Va.; 24th, Va., Ga., Dak.; 25th, Dak., Minn., Conn., N. Y.; 26th, Mo., Minn., Mass., Mich.; 27th, Iowa, Ind., Ill., Ohio; 28th, Mich., Mass., Kan., N. Y., Va.; 29th, Pa., N. Y., Me., Ga., Ohio, Kan., Conn., Ill., Va.; 30th, Va., Ga., Iowa, Ala., N. C., Ill., Wis.; 31st, S. C., Iowa, N. C., Ga., Ohio, Fla., Dak., Ill., Ind., N. J., Va., Wis.

*Auroras* were observed as follows: Vevay, Ind., 2nd and 5th; West Charlotte, Vt., 7th; Duluth, Minn., 8th, 16th and 17th; Northport, Mich., 9th; Monticello, Iowa, 10th; Cambridge, Mass., and Cleveland, Ohio, 16th; Swansey, N. H., 17th; Bangor, Me., 18th and 30th.

*Ground Currents*.—Disturbances on lines of telegraph have been reported as follows: At Pike's Peak, Col., 6th; Fort Sill, Ind., Ty., 7th; Laredo, Texas, 8th, 9th and 10th; Bismarck, Dak., 24th, (line not working,) and 27th.

### OPTICAL PHENOMENA.

*Solar Halos*.—1st, Mich.; 2nd., Me., Ohio, R. I., Conn.; 3rd, Fla.; 4th, Fla.; 6th, Ohio, Ky.; 7th, N. Y.; 8th, Ill.; 9th, La.; 10th, Iowa; 11th, Dak., Ill., Ohio, Ky., Fla., N. C., Mich.; 12th, Miss., Va.; 13th, Ga.; 14th, S. C.; 15th, N. C.; 17th, Miss., N. Y., Conn., Cal.; 18th, Me., N. C.; 20th, Conn., Mass., N. J., N. Y., S. C., R. I., Ga., N. C.; 21st, Ill., Iowa, N. Y., Vt., S. C., N. C., Conn.; 22nd, Ill., Ohio, S. C., Ky., N. C.; 23rd, Wis., S. C.; 24th, Ga.; 25th, R. I., N. C.; 26th, Fla., Ga., N. C., Conn.; 27th, Ill., Miss., Fla., Mich., N. C.; 28th, N. C., S. C., La.; 29th, N. C.; 30th, Mich.; 31st, Conn., Me., N. Y., R. I., Ga.

*Lunar Halos*.—1st, Conn.; 14th, Ind.; 15th, Mo.; 16th, Texas, Mo.; 17th, Mass., N. H., Ind., Ohio, Ala., Cal.; 18th, Va., S. C., N. H., N. J., Ga., Ohio, N. C.; 19th, N. J., N. C., Tenn., Va., N. Y., Ohio, Mich.; 20th, Iowa, Vt., S. C., N. H., N. C., Neb., Fla., Mo., Ala., Mich.; 21st, Ind., Iowa, Me., Mich., N. J., N. Y., Ohio, Vt., N. H., Neb., Fla.; 22nd, Mass., Mich., Ohio, Va., W. Va., N. C., Penn., Fla., Conn., Wis., Minn.; 23rd, Mass., Me., Ind., N. Y., Iowa, Conn., Me., Penn., Ala., Minn.; 24th, Mass., Va., S. C., W. Va., Iowa, Kan., Ga.; 25th, Ill., Mass., N. Y., S. C., N. C., Ind., Fla.; 26th, Fla., Mich., W. Va., N. C., Mo., D. C.; 27th, Mo., Ala., Ga.; 28th, Ga., S. C., N. C., Minn.; 29th, Wis.; 30th, R. I., Mo.; 31st, N. Y.

*Mirage*.—2nd, Olivet, Dak.; 3rd, Duluth, Minn.; 4th and 15th, Tybee Island, Ga.; 13th, Indianola, Tex.; 25th, Rochester, N. Y.

### MISCELLANEOUS PHENOMENA.

**BIRDS.**—*Martins*, had left Morgantown, W. Va., 11th, were leaving Bellefontaine, Ohio, on the 1st, and Jacksonburg, Ohio, on the 13th. *Swallows*, had left Morgantown, W. Va., 17th.; were seen flying southward in great numbers, at Daytona, Fla., 14th and 21st; congregating in large numbers at Baxter Springs, Kan., 2nd; left Jacksonsburg, Ohio, 23rd; Bellefontaine, Ohio, leaving 22nd. *Bobolinks*, was last seen at Vermillion, N. Y., 1st. *Wild Geese*, Sacramento, Cal., (first of season), passed from N., 30th. *Wild Ducks*, were seen at Lower Brule Agency, Dak., flying S., 26th. *Herons*, were seen flying S., at Wappinger's Falls, N. Y., 26th.

**INSECTS.**—*Grasshoppers*, Minnesota, sixteen counties have sustained an appreciable loss from grasshoppers this year; in Kandiyohi and Chippewa, the destruction was complete, and in the remaining thirteen the ravages are estimated at  $\frac{1}{2}$  to  $\frac{3}{4}$  of a full crop. In a strip fifty miles in width by one hundred and twenty-five in length, extending from Otter Tail Lake to the Minnesota river, fully one fourth of the farmers raised nothing, and the remainder very little. Idaho, 7th, in Dixie valley "hoppers" have destroyed oat crop. In Boise valley, ravages thus far only partial and local. They are somewhat worse this year, but there has been nothing approaching to the ravages in the region beyond the Rocky Mountains, Montana, Virginia City, 1st, large swarm flying northeast, first of season; Dakota, Bismarck, 2nd, abundant, 9th, very few; Yankton, 1st, 12th and 15th; Ft. Sisseton, fly SE. 1st and 2nd; Olivet, 1st, large flight of locusts, S. and 8th, SE. Iowa, Des Moines valley, grasshoppers plentiful, but doing no damage. Nebraska, North Platte, Locust flying west in myriads; Emerson, SW. 7th, 8th, 9th, 25th, and NE. 10th; Plattsburgh, SW. 2nd, NW. 3rd and 4th; Clear Creek, S. 1st, W. 2nd, N. 3rd, S. 6th to 9th, N. 10th, SW. 11th, 12th, 14th; Genoa, S. 1st, 2nd, 6th, SE. 7th, S. and W. 8th to 14th, N. 19th. Utah, very little damage, except in Cache valley. Canada Ottawa, Augusta township, 7th, so numerous that farmers were cutting oats in order to save them.

*Polar Bands*.—Carthagena, Ohio, 1st, 6th, 7th, 11th; Gardiner, Me., 2nd, 20th; Wytheville, Va., 5th, 6th, 9th, 22nd, 23rd, 25th, 26th, 27th; Auburn, N. H., 8th, 13th; Tabor, Ohio, 18th; Portsmouth, N. C., (from SW. to NE.) 20th; Woodstock, Vt., 21st, 23rd; Rowe, Mass., 23rd; Guttenburg, Iowa, 25th; Jacksonburg, Ohio, 25th; Freehold, N. J., 26th, 30th; Charlestown, S. C., 29th.

**Sunsets.**—The characteristics of the sky, as indicative of approaching fair or foul weather, have been observed daily at sunset, at all Signal Service stations. The monthly means from 104 stations show that 75 doubtful cases or blanks were recorded, and that out of the remaining 3,149 cases, 2,521 or 80.6 per cent. have been followed by the expected weather.

**Forest-fires.**—Wisconsin, 5th, the villages of Eaton and Benjamin, Brown Co., were almost totally destroyed; the forest has been burning for five weeks, destroying millions of feet of lumber and thousands of dollars of other property; one family is said to have perished and four more families are missing; a large number of animals were also burned. Michigan, 13th, Rosemon Co., large forest-fires raging in this region, destroying thousands of dollars worth of pine timber. Canada, 6th, Bertie Station, cedar bush burned over six miles. Morristown, Dak., 20th; Bismarck and Lower Brule Agency, Dak., 25th; Monticello, Iowa, S., 27th; Fort Sisseton, Dak., N. and E., 28th and 29th; Oregon, Mo., (in Kansas) 31st.

**Meteors.**—Monticello, Iowa; North Volney, N. Y.; Tybee Island, Ga. 2nd. Monticello and Davenport, Iowa; Linden, N. J.; Tybee Island, Ga.; La Crosse, Wis. 3d, Cresco and Davenport, Iowa; North Volney, N. Y.; Savannah, Ga. 4th, Southington, Conn.; Cresco and Davenport, Iowa; Litchfield, Mich.; Green Castle, Pa.; Savannah and Tybee Island, Ga. 5th, Vevay, Ind.; Atco, N. J.; Carthagena, Ohio; Santa Fe, N. Mex. 6th, Southington, Conn.; Daytona, Fla.; Green Castle, Pa.; Wautoma and La Crosse, Wis. 7th, Davenport, Iowa; Leavenworth, Kans.; Uvalde, Tex. 8th, Como, Ill.; Oregon, Mo.; Norfolk, Neb.; Linden, N. J.; Louisville, Ky.; Keokuk and Davenport, Ia.; Leavenworth, Kans.; Breckenridge, Minn.; Jacksonburg, O. 9th, Cresco, Dubuque, Keokuk and Davenport, Iowa; Brookhaven, Miss.; Oregon, Mo.; Carthagena and Jacksonburg, Ohio; Wautoma, Wis.; Morgantown, W. Va.; Louisville, Ky.; North Platte, Neb.; Santa Fe, N. Mex.; Duluth, Minn. 10th, Cresco, Monticello, Dubuque and Davenport, Iowa; Fall River, Mass.; Norfolk, Neb.; Freehold, N. J.; Waterburgh, N. Y.; Weldon, Greenville and Cape Lookout, N. C.; Carthagena and Jacksonburg, Ohio; Wautoma and Milwaukee, Wis.; Louisville, Ky.; Denison, Texas; Savannah and Tybee Island, Ga.; Fort Gibson, Ind. Ter.; St. Louis, Mo.; Duluth, Minn.; Santa Fe, N. Mex.; Visalia, Cal. 11th, Southington, Conn.; Fall River, Mass.; Corning, Mo.; Freehold, N. J.; Carthagena and Jacksonburg, Ohio; Greencastle, Pa.; Hampton, Va.; Santa Fe, N. Mex.; Wautoma and Milwaukee, Wis.; Savannah and Tybee Island, Ga.; Fort Gibson, Ind. Ter.; Dubuque and Davenport, Iowa. 12th, Southington, Conn.; Somerset, Mass.; Philadelphia, Pa.; Hampton, Va.; Savannah and Tybee Island, Ga.; Keokuk, Iowa. 13th, Melissa, Tex.; Keokuk and Davenport, Iowa; Leavenworth, Kan.; St. Louis, Mo. 14th, Flushing, N. Y.; St. Louis, Mo.; Melissa, Tex. 15th, Vevay, Ind.; Dubuque and Davenport, Iowa. 16th, Atco, N. J.; Corning, Mo.; Davenport, Iowa. 18th, Monticello, Iowa; Freehold, New Jersey. 19th, La Crosse, Wisconsin. 20th, Summit, Colorado. 21st, Auburn, New Hampshire. 22nd, Monticello, Iowa. 23rd, Anna, Ill.; Point Pleasant, La. 24th, Independence, Iowa; Weldon, N. C. 25th, Fayette, Miss. 26th, Como, Ill.; Woodstock, Md.; Freehold, N. J.; Philadelphia, Pa., Dubuque, Iowa. 27th, Southington, Conn.; Woodstock, Md.; Litchfield, Mich.; Weldon, N. C.; Indianapolis, Ind. 28th, Emerson, Neb.; Waterburgh, N. Y.; Leavenworth, Kan. 29th, Anna, Ill.; Woodstock, Md.; Corning, Mo.; Waterburgh, N. Y.; Tybee Island, Ga.; Davenport, Iowa. 30th, Southington, Conn.; Vevay, Ind.; Clear Creek and Emerson, Neb.; Tybee Island, Ga. 31st, Fayette, Miss.; Hulmeville, Pa.; Davenport, Iowa.

**Zodiacal Light.**—Monticello, Iowa, 2nd, 3rd, 4th, 5th, 8th, 9th, 10th, 13th and 14th; Savannah, Ga., 3rd, 6th, 7th, 26th, 27th, 29th and 31st.

**Earthquakes.**—Michigan, 17th, Detroit, 11 A. M., slight earthquake-shock in western portion of city. Redford, about 10:50 A. M., shock of one minute duration; seemed to come from a southwesterly direction. Greenfield, "shock resembled sound of a double clap of thunder under ground, lasting about one minute, causing houses to tremble, horses plowing stopped immediately, sky perfectly clear and weather hot." Livonia, 11 A. M., lasting about thirty seconds, direction northeast; "at first like a heavy clap of thunder and then rolled like a heavy train of cars." California, Campo, 17th, 7:30 P. M., heavy shock, lasting fifteen seconds; loud rumbling, pictures thrown from walls. New Jersey, Florence, 10th, shock lasting several seconds, accompanied by dull rumbling sound.

The Weather Review for May gave a description of the earthquake-wave of the 9th and 10th; later advices show that this wave reached New South Wales on the 11th of May. At 5h., 20s., a. m., (Australian time,) the tide-gauge at Fort Denison recorded the first of a series of waves. The oscillations continued through the day and reached their maximum at 2 p. m., the height then being three feet six inches. It is also reported that similar waves were felt at New Zealand, the maximum height being six feet.

**Volcanic Eruptions.**—Advices from Kilauea, Hawaii, state that the lake which a few weeks ago was empty is now full of activity and filled with molten lava.

## SOLAR PHENOMENA.

*Sun spots*.—The following observations, made by Mr. D. P. Todd, upon the spots of the sun, have been kindly communicated by Rear Admiral John Rodgers, U. S. N., Superintendent of the Naval Observatory:

August, 1877.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
3rd, 2 p. m...	0	0	0	4	0	0	1	1	
4th, 8 a. m...	0	0	0	0	0	0	0	0	
4th, 5 p. m...	0	0	0	0	0	0	0	0	
5th, 10 a. m...	0	0	0	0	0	0	0	0	
5th, 8 p. m...	0	0	0	0	0	0	0	0	
6th, 10 a. m...	0	0	0	0	0	0	0	0	
6th, 10 a. m...	0	0	0	0	0	0	0	0	
7th, 10 a. m...	0	0	0	0	0	0	0	0	
8th, 8 a. m...	0	0	0	0	0	0	0	0	
11th, 8 a. m...	0	0	0	0	0	0	0	0	
11th, 8 p. m...	0	0	0	0	0	0	0	0	
12th, 10 a. m...	0	0	0	0	0	0	0	0	
14th, 2 p. m...	0	0	0	0	0	0	0	0	
17th, 9 a. m...	0	0	0	0	0	0	0	0	
17th, 5 p. m...	0	0	0	0	0	0	0	0	
18th, 9 a. m...	0	0	0	0	0	0	0	0	
19th, 2 p. m...	0	0	0	0	0	0	0	0	
20th, 5 p. m...	0	0	0	0	0	0	0	0	
22nd, 5 p. m...	1	2	0	0	1	2	1	2	
24th, 4 p. m...	0	6	0	0	0	6	1	6	
25th, 4 p. m...	0	0	0	0	0	0	1	0	
26th, 5 p. m...	0	0	0	0	0	0	1	0	
28th, 5 p. m...	0	0	0	0	0	0	1	0	
29th, 5 p. m...	0	0	0	0	0	0	1	0	
30th, 5 p. m...	0	0	0	0	0	0	1	2	

## NOTES AND EXTRACTS.

*Winds of the South Atlantic*.—M. Brault announces the publication, by the French Marine, of a series of new meteorological charts, giving the direction and force of the winds of the South Atlantic for each of the four seasons, the charts being similar to those published by M. Brault about two years ago, on the winds of the North Atlantic. The new charts contain the result of 189,773 observations of the wind. The general movement of the winds in summer over this portion of the globe, resemble an immense whirl, whose centre is about  $30^{\circ}$  to  $35^{\circ}$  latitude S., and  $10^{\circ}$  to  $20^{\circ}$  longitude W. The whirling movement is in a direction contrary to that of the hands of a watch, being thus opposite to the general circulation of the atmosphere over the North Atlantic in summer. Out of this centre winds blow in all directions, the more important being the southeast trades, which are deflected to south and south-southwest off the coast of Africa, and to east-southeast and east on approaching the coast of America; these in succession, northeast, north and northwest winds on advancing southward along the coast of America, merging finally in the westerly winds which blow across the Atlantic from Cape Horn to the Cap of Good Hope. Looking both at the force and direction of the winds, M. Brault concludes that the results establish beyond a doubt the fact that, contrary to the views entertained up to a comparatively recent date, there does not exist any tropical zone stretching across the South Atlantic, characterized by the prevalence of calms and light variable breezes. These results are entirely in accord with recent researches into the atmospheric movements over this region, and are of peculiar interest when viewed in connection with the distribution of atmospheric pressure and its variation, with season, over South America, the South Atlantic and South Africa.—Nature, Aug. 2nd.

M. Alluard, Director of the Observatory at Puy-de-dome, France has noticed some remarkable differences of pressure, as indicated by self-registering barometers. One was placed at the summit of Puy-de-dome and the other at Clermont-Ferrand, distant about seven English miles, and remarkable discrepancies were found on comparing the two records, which could not be satisfactorily explained by differences of temperature nor by Laplace's formula for the barometric determination of heights.

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*Albert J. Myers*

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Brig. Gen. (Bvt. Asstg'd.) Chief Signal Officer, U. S. A.